

Low-concentration liquid phenol demonstrates similar therapeutic success to high-concentration and crystallized phenol in pilonidal sinus management

Low-concentration phenol in pilonidal sinus treatment

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Abstract

Aim: Pilonidal sinus disease (PSD) is a common inflammatory condition in young adults. Crystallized phenol and 80% liquid phenol are widely used conservative options but may cause adverse effects such as skin and fat necrosis. Recently, low-concentration liquid phenol has been suggested as a safer alternative. This study aimed to compare the efficacy and safety of three phenol-based treatments.

Materials and Methods: This retrospective study included 126 patients with primary, uncomplicated PSD treated between October 2020 and May 2022. Patients were divided into three groups: crystallized phenol (Group A, n=42), 80% liquid phenol (Group B, n=43), and 40% diluted phenol (Group C, n=41). Groups were stratified by sinus count (<2 or ≥2). Baseline features (age, BMI, comorbidities, smoking, alcohol use) were similar. All procedures were performed under local anesthesia in an outpatient setting. Postoperative complications (infection, bleeding, fat and skin necrosis) were assessed on days 3, 7, and 21. Recurrence was monitored for 24 months. ANOVA and Chi-square tests were applied.

Results: Mean age was 28.7 years; 88.9% were male. Recurrence rates were comparable (A: 11.9%, B: 9.7%, C: 10.4%; p>0.05). Skin necrosis occurred in four patients in Group A, three in Group B, and none in Group C. Abscesses developed in three patients in Groups A and B, and one in Group C. No major bleeding was observed.

Discussion: Low-concentration phenol offered similar efficacy with fewer complications and may be a safe, effective option for PSD treatment.

Keywords

pilonidal sinus, phenol therapy, minimally invasive, recurrence, skin necrosis

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Introduction

Pilonidal sinus disease (PSD) is a chronic inflammatory condition affecting the sacrococcygeal region, primarily in adolescents and young adults, with a marked male predominance and an estimated incidence of 26 per 100,000 population annually [1,2]. The etiology is multifactorial, involving local mechanical forces, hair insertion, and repeated trauma leading to sinus formation and secondary infection [3].

While wide excision has historically been the mainstay of treatment, it is associated with prolonged healing and high morbidity [4]. Conservative outpatient treatments using phenol have gained popularity due to shorter recovery times and reduced complication rates [5]. Crystallized phenol and 80% liquid phenol are the most widely used forms, but both can cause significant local tissue toxicity, including skin and fat necrosis [6].

Low-concentration liquid phenol has recently gained attention as a potentially safer alternative, though comprehensive comparative evidence remains limited [7]. Furthermore, studies directly comparing the efficacy and complication profiles of all three phenol formulations-crystallized, high-concentration, and low-concentration are scarce.

The present study aimed to compare the clinical outcomes and complication rates of these three phenol-based treatment modalities in patients with primary, non-complicated PSD, using standardized follow-up over a 24-month period.

Materials and Methods

Patient Selection and Group Allocation

This retrospective study included 126 adult patients with primary, non-complicated pilonidal sinus disease treated at a tertiary-level general surgery clinic between October 2020 and May 2022. Inclusion criteria were: age ≥ 18 years, absence of prior pilonidal surgery, and availability of 24-month clinical follow-up. Patients were excluded if they had recurrent disease, acute pilonidal abscess, anorectal comorbidities, or incomplete clinical data.

Patients were stratified based on the number of sinus openings into:

- Single-pit disease
- Multiple-pit disease

Following stratification, patients were allocated into three treatment groups:

- Group A (n=42): Crystallized phenol
- Group B (n=43): 80% liquid phenol
- Group C (n=41): 40% diluted phenol (prepared by mixing equal parts of 80% phenol and 0.9% saline)

All procedures were performed under local anesthesia in an outpatient setting.

Ethical approval was granted by the Clinical Research Ethics Committee of Afyonkarahisar Health Sciences University (Meeting No: 2022/7, Approval Date: 03/06/2022), and written informed consent was obtained from all participants.

Data Collection

Demographic and clinical data were recorded, including age, sex, body mass index (BMI), weight, smoking and alcohol use, comorbidities, and the number of sinus pits (classified as single-pit or multiple-pit disease). All data were prospectively

collected using standardized outpatient clinic forms.

Follow-up assessments were conducted on postoperative days 3, 7, and 21, and at regular intervals for 24 months. Complications such as wound infection, abscess, fat necrosis, skin necrosis, and bleeding were documented. Recurrence was defined as the reappearance of symptoms or sinus openings after initial healing.

Phenol Application Procedure

Before the procedure, all patients were instructed to completely shave the sacrococcygeal region. Local anesthesia was administered with up to 5 cc of lidocaine. After mechanical debridement of hair and granulation tissue using mosquito forceps, a protective layer of nitrofurazone cream was applied around the sinus openings to prevent skin contact with phenol. The application techniques for each phenol type were standardized according to the recommendations of Kayaalp and Tolan [8]:

- In Group A, small fragments of crystallized phenol were inserted directly into the sinus tract and retained for approximately five minutes, allowing slow liquefaction and diffusion while minimizing leakage into surrounding tissues.
- In Group B, 1 mL of 80% liquid phenol was instilled via a plastic IV cannula and retained in the cavity for five minutes before being drained.
- In Group C, 0.5 mL of 80% phenol was diluted with 0.5 mL of 0.9% saline to prepare a 1 mL 40% phenol solution, which was applied in the same manner and for the same duration as in Group B.

Following the application period, excess phenol was gently evacuated by external pressure, and the wound was left open without dressing. All procedures were performed in an outpatient setting.

Follow-up Process

Routine follow-up evaluations were conducted on days 3, 7, and 21 post-treatment, and then at monthly intervals for 24 months. Infections were treated with oral second-generation cephalosporins when necessary. Analgesics were prescribed only if clinically indicated.

Healing was defined as complete epithelialization of the sinus orifices without discharge or signs of inflammation. Recurrence and complications were systematically documented throughout the follow-up period.

Statistical Analysis

Continuous variables (e.g., age, BMI, weight) were assessed for normality using the Shapiro-Wilk test. Normally distributed variables were compared using one-way analysis of variance (ANOVA).

Categorical variables (e.g., gender, smoking, recurrence, complications) were analyzed using Pearson's Chi-square test or Fisher's Exact test when expected cell counts were < 5 . Statistical significance was set at $p < 0.05$. When necessary, post-hoc comparisons were performed using the Tukey HSD test.

All analyses were performed using IBM SPSS Statistics version 27.0 (IBM Corp., Armonk, NY, USA).

Ethical Approval

This study was approved by the Clinical Research Ethics Committee of Afyonkarahisar Health Sciences University (Date:

2022-06-03, No: 2022/7). Written informed consent was obtained from all participants.

Results

A total of 126 patients with primary, non-complicated pilonidal sinus disease were included in the study. There were 42 patients in Group A (crystallized phenol), 43 in Group B (80% phenol), and 41 in Group C (low-concentration phenol). Among the 126 patients, 112 (88.9%) were male and 14 (11.1%) were female, with no significant gender difference across groups ($p=0.782$). Similarly, smoking status ($p=0.609$), alcohol use ($p=0.691$), and comorbidity rates ($p=0.734$) were comparable among the groups. Baseline demographic characteristics of the patients are summarized in Table 1.

Mean age was 28.7 ± 5.3 years, with no significant difference among groups (Group A: 28.4 ± 5.4 , Group B: 28.9 ± 5.1 , Group C: 28.8 ± 5.5 ; $p=0.841$). Mean BMI and body weight were also similar across groups (BMI: $p=0.766$; weight: $p=0.712$), supporting the demographic comparability across groups.

Postoperative outcomes and complication rates at 24 months are presented in Table 2. In terms of postoperative outcomes (Table 2), recurrence rates at 24 months were 11.9% in Group A, 9.7% in Group B, and 10.4% in Group C, with no statistically significant difference observed ($p=0.923$, Pearson chi-square).

Table 1. Baseline demographic characteristics of the patients

Variable	Group A (n=42)	Group B (n=43)	Group C (n=41)	p value
Age (years, mean $\pm$ SD)	28.4 $\pm$ 5.4	28.9 $\pm$ 5.1	28.8 $\pm$ 5.5	0.841
BMI (kg/m ² , mean $\pm$ SD)	24.6 $\pm$ 2.9	25.0 $\pm$ 3.1	24.7 $\pm$ 2.8	0.766
Weight (kg, mean $\pm$ SD)	73.5 $\pm$ 9.8	75.4 $\pm$ 10.1	74.8 $\pm$ 9.6	0.712
Gender (Male), n (%)	37 (88.1%)	39 (90.7%)	36 (87.8%)	0.782
Smoking, n (%)	15 (35.7%)	16 (37.2%)	13 (31.7%)	0.609
Alcohol Use, n (%)	10 (23.8%)	12 (27.9%)	9 (22.0%)	0.691
Comorbidity, n (%)	8 (19.0%)	9 (20.9%)	7 (17.1%)	0.734
Pit Count $\geq$ 2, n (%)	19 (45.2%)	21 (48.8%)	18 (43.9%)	0.845

SD: standard deviation; BMI: body mass index.

Table 2. Postoperative outcomes and complications

Variable	Group A (n=42)	Group B (n=43)	Group C (n=41)	p value
Recurrence, n (%)	5 (11.9%)	4 (9.7%)	4 (10.4%)	0.923
Skin Necrosis, n (%)	4 (9.5%)	3 (7.0%)	0 (0%)	0.034
Fat Necrosis, n (%)	4 (9.5%)	5 (11.6%)	2 (4.9%)	0.447
Abscess, n (%)	3 (7.1%)	3 (7.0%)	1 (2.4%)	0.541
Major Bleeding	–	–	–	–

Table 3. Postoperative outcomes according to pit count within treatment groups

Group	Pit Count	No. of Patients (n)	Recurrence, n (%)	Abscess, n (%)	Skin Necrosis, n (%)
Group A	Single	23	2 (8.7%)	1 (4.3%)	0 (0%)
	Multiple	19	3 (15.8%)	2 (10.5%)	4 (21.1%)
Group B	Single	22	1 (4.5%)	1 (4.5%)	1 (4.5%)
	Multiple	21	3 (14.3%)	2 (9.5%)	2 (9.5%)
Group C	Single	23	1 (4.3%)	0 (0%)	0 (0%)
	Multiple	18	3 (16.7%)	1 (5.6%)	0 (0%)

Skin necrosis was noted in 4 patients in Group A (9.5%) and 3 patients in Group B (7.0%), while no cases were detected in Group C ($p=0.034$). Fat necrosis occurred in 4 patients in Group A (9.5%), 5 in Group B (11.6%), and 2 in Group C (4.9%), but this was not statistically significant ($p=0.447$). Abscess formation was recorded in 3 patients each in Groups A and B and in 1 patient in Group C ($p=0.541$).

When stratified by pit count (<2 vs ≥ 2), recurrence and complication rates did not significantly differ between subgroups within each treatment arm ($p>0.05$ for all comparisons). There was no statistically significant interaction between pit number and treatment modality regarding recurrence ($p=0.681$) or complication rates.

No major bleeding events or unplanned readmissions occurred in any group throughout the follow-up period.

When stratified by pit count (<2 vs ≥ 2), recurrence and complication rates were descriptively higher in patients with ≥ 2 pits, particularly in Group A and Group B. However, no statistically significant differences were observed between the subgroups within each treatment arm ($p>0.05$ for all comparisons). Notably, skin necrosis was observed only in the ≥ 3 pit subgroups of Group A (4 patients) and Group B (2 patients), whereas no cases were recorded in Group C, regardless of pit count. Detailed postoperative outcomes stratified by pit count are shown in Table 3.

Discussion

Our study confirms the efficacy and safety of phenol-based minimally invasive approaches in treating pilonidal sinus disease (PSD), with comparable recurrence rates across all three phenol formulations and a markedly lower incidence of complications in the low-concentration phenol group. Phenol treatment has become increasingly favored over traditional excisional surgery due to its simplicity, outpatient applicability, and lower wound morbidity [1,4]. Surgical techniques such as the modified Limberg flap have demonstrated favorable outcomes in selected cases, although they typically require operating room conditions and longer recovery periods [9]. Comparative studies have shown that flap techniques such as Limberg and Karydakis can be effective but are often associated with higher surgical burden and longer convalescence [10]. This is further supported by a recent single-center experience using the modified Limberg flap, which demonstrated acceptable outcomes but with longer healing times and hospital-based requirements [11].

Recent meta-analyses demonstrate its non-inferiority to surgical excision regarding recurrence, and its superiority concerning recovery time and complication rates [12,13].

Crystallized phenol remains one of the most widely adopted techniques for PSD, offering high success rates with minimal intervention. Sakcak et al. reported a recurrence rate of 7.4% and low complication rates among 112 patients treated with crystallized phenol [6]. Similarly, Omarov et al. demonstrated a 96% success rate in a recent Turkish cohort, with recurrence associated with factors such as obesity and hirsutism [14]. Our Group A, which received crystallized phenol, showed a comparable recurrence rate of 11.9% and isolated, self-limited cases of fat necrosis, which aligns with previously published findings.

High-concentration (80%) liquid phenol remains a standard option, but concerns regarding local tissue toxicity have prompted the exploration of alternative strategies [5]. In our Group B, recurrence and overall efficacy were similar to Group A, but minor soft tissue complications, including skin necrosis (7.0%) and fat necrosis (11.6%), were slightly more common—consistent with previous reports [5,6].

Low-concentration phenol has recently been explored as a potentially safer alternative. Emiroglu et al. reported similar efficacy and fewer local side effects using diluted phenol (30%) [7]. In our Group C, recurrence was 10.4% with no cases of skin necrosis, suggesting a better safety profile without compromising effectiveness. This supports the increasing literature favoring low-concentration protocols in suitable patients [7,13].

A recent single-center retrospective study by Demir et al. compared crystallized and high-concentration liquid phenol applications in 80 patients with pilonidal sinus disease and found no significant difference in one-year success rates (90% vs. 95%). However, the liquid phenol group experienced a significantly higher rate of early complications (37.5% vs 15%; $p=0.042$), including skin maceration, cellulitis, and hematoma [15]. These findings align with our results, where high-concentration phenol (Group B) was associated with higher skin and fat necrosis rates compared to both crystallized (Group A) and low-concentration phenol (Group C). The absence of skin necrosis in Group C further supports the notion that reducing phenol concentration and adjusting delivery technique may minimize chemical injury to adjacent tissues.

Azizoglu et al. recently reported favorable outcomes using platelet-rich plasma (PRP) as an adjuvant to crystallized phenol in pediatric patients, demonstrating reduced healing time and recurrence [16]. Although promising, their findings are limited to pediatric populations, which restricts direct comparison with our adult cohort.

Silver nitrate has recently emerged as a promising minimally invasive alternative in the management of pilonidal sinus disease (PSD), particularly for patients who are not suitable candidates for phenol-based interventions. Kılıcı et al. conducted a retrospective study involving patients treated with pit excision followed by silver nitrate application and reported a 78.6% complete healing rate at 12 months, with minimal adverse effects and short outpatient recovery times [17]. Similarly, Kanat et al. evaluated silver nitrate as a standalone mini-invasive therapy and found a 91.1% cure rate with a mean healing time of 15.6 days and a complication rate of 22.2%, demonstrating the practicality of silver nitrate in outpatient protocols [18]. In a comparative study, Taskin and Karabay directly assessed crystallized phenol versus silver nitrate and found similar recurrence rates at one-year follow-up (12.8% vs. 28.9%, respectively; $p>0.05$), although silver nitrate required more frequent applications. Interestingly, silver nitrate was associated with reduced postoperative pain and no observed cases of skin necrosis, which the authors attributed to its relatively milder caustic effect compared to phenol [19]. These findings align partially with our study, in which low-concentration liquid phenol achieved a recurrence rate of 10.4%—comparable to the success rates of both crystallized phenol and silver

nitrate—while completely avoiding skin necrosis. Although our protocol did not incorporate silver nitrate, the favorable safety profile and efficacy of low-concentration phenol in our cohort suggest that it may offer similar advantages without the need for repeated applications. Taken together, these studies reinforce the evolving role of non-excisional chemical therapies in PSD and support individualized treatment planning based on tissue tolerance, patient comorbidities, and logistical feasibility. Systematic reviews continue to confirm that phenol-based and other non-excisional techniques are effective and associated with lower morbidity compared to surgical excision. In the 2023 systematic review by Huurman et al., recurrence rates for methods such as pit picking (with adjunctive phenol, laser, or endoscopic techniques) ranged from 0 % to 29 %, and wound healing times varied between 3 and 47 days, depending on application frequency and technique [13]. Our protocol, which involved single-session outpatient phenolization and structured follow-up, falls well within this favorable range.

Stratification by pit number revealed no significant relationship with recurrence or complication rates in our series. This supports previous observations that pit count alone is not a reliable prognostic factor in minimally invasive PSD management [2].

Limitation

This study has several limitations. It is a single-center retrospective analysis with a modest sample size, which may limit external validity. Although data were prospectively collected, the absence of a surgical or silver nitrate control group restricts comparative interpretation. Additionally, our follow-up was limited to 24 months and may not fully reflect long-term recurrence trends.

Moreover, since all patients were discharged home on the day of the procedure, postoperative pain assessment using standardized scoring systems such as the visual analog scale (VAS) could not be performed, limiting our evaluation of immediate patient comfort.

Future multicenter randomized studies with extended follow-up are warranted to further clarify the relative merits of various phenol concentrations and alternative chemical agents.

Conclusion

Low-concentration phenol yielded comparable therapeutic success to high-concentration and crystallized phenol in the management of primary pilonidal sinus disease. The absence of skin necrosis and low complication rates in the low-concentration group underscore its clinical advantage, supporting its use as a safe and effective conservative treatment option in routine outpatient clinical practice.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and Human Rights Statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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